

Amendments to the Claims

1-113 (Cancelled)

114. (New): A wheel, comprising:

a peripheral wheel rim;

a central hub with a central axle and an outer flange;

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a plurality of spokes extending between the rim and hub, wherein said spokes have a first portion connected to said rim and a second portion opposed to said first portion and connected to said hub; and

a cavity formed within at least one of said outer flange and said rim for connection with at least one of said spokes and being a blind cavity including at least one open end and closed longitudinal sides and a closed bottom,

wherein at least one of said first portion and said second portion of said spoke is joined to at least one of said outer flange and said rim by means of a deformed engagement in a deformed engagement region, said cavity surrounding and enclosing the cross section of said spoke at said deformed engagement region; and

wherein said deformed engagement results in a firm connection between said cavity and at least one of said first portion and said second portion of said spoke at said engagement region.

115. (New): A wheel, comprising:

a peripheral wheel rim;

a central hub with a central axle and an outer flange;

a plurality of spokes extending between the rim and hub, wherein said spokes have a first portion connected to said rim and a second portion opposed to said first portion and connected to said hub; and

a cavity formed within at least one of said outer flange and said rim for connection with at least one of said spokes,

wherein at least one of said first portion and said second portion of said spoke is joined to at least one of said outer flange and said rim by means of a deformed engagement in a deformed engagement region; and

wherein there is a difference in hardness between the material of said cavity and the material of said spoke in said deformed engagement region, at least one of said spoke and said cavity being softer than the mating spoke or cavity; and

wherein said deformed engagement results in a firm connection between said cavity and said at least one of said first portion and said second portion of said spoke at said engagement region.

116. (New): The wheel of claim 115 wherein said spoke is threaded in said deformed engagement region.

117. (New): The wheel of claim 115 wherein the deformed engagement is effective to resist pull out of each spoke from the associated cavity.

118. (New): The wheel of claim 115 wherein the deformed engagement comprises elastic deformation.

119. (New): The wheel of claim 115 wherein the deformed engagement comprises plastic deformation.

120. (New): The wheel of claim 115 wherein the deformed engagement comprises elastic deformation and plastic deformation.

121. (New): A wheel according to claim 115, wherein said spoke includes a non-circular cross-section portion located within said deformed engagement region wherein said non-circular cross-section portion has a generally flat cross-section with a cross-sectional width greater than thickness.

122. (New): A wheel according to claim 115, wherein said cavity is in a polymeric material.

123. (New): A wheel according to claim 122, wherein said polymeric material includes reinforcement fibers.

124. (New): A wheel, comprising:

a peripheral wheel rim;

a central hub with a central axle and an outer flange;

a plurality of pretensioned spokes extending between the rim and hub, wherein said spokes have a first portion connected to said rim and a second portion opposed to said first portion and connected to said hub; and

a cavity formed within at least one of said outer flange and said rim for connection with at least one of said spokes,

wherein at least one of said first portion and said second portion of said spoke is joined to at least one of said outer flange and said rim by means of a deformed engagement in a deformed engagement region, said cavity surrounding and enclosing the cross section of said spoke at said deformed engagement region; and

wherein said deformed engagement results in a firm connection between said cavity and at least one of said first portion and said second portion of said spoke at said engagement region.

125. (New): A wheel according to claim 124, wherein said spoke includes a non-circular cross-section portion located within said deformed engagement region to limit rotation of said spoke relative to said cavity.

126. (New): A wheel according to claim 124, wherein said at least one of said outer flange and said rim includes raised external geometry adjacent said cavity to at least one of locally extend and locally support said deformed engagement region.

127. (New): The wheel of claim 124 further comprising means for adjusting tension in the plurality of pretensioned spokes.

128. (New): The wheel of claim 124 wherein the engagement region includes contact between said at least one spoke and said cavity around the full cross-sectional perimeter of said spoke.

129. (New): The wheel of claim 124 wherein the cavity is in a polymeric element.
130. (New): The wheel of claim 129 wherein said spoke is threaded in said deformed engagement region.
131. (New): The wheel of claim 124 wherein the cavity is oriented axially and the spoke includes a bent region.
132. (New): A wheel, comprising:
a peripheral wheel rim;
a central hub with a central axle and an outer flange;
a plurality of spokes extending between the rim and hub, wherein said spokes have a first portion connected to said rim and a second portion opposed to said first portion and connected to said hub; and
a cavity formed within at least one of said outer flange and said rim for connection with at least one of said spokes,
wherein at least one of said first portion and said second portion of said at least one of said spokes is coupled to at least one of said outer flange and said rim by means of an interference fit.
133. (New): A wheel according to claim 132, including at least one reinforcement element connected to at least one of said rim and said outer flange, wherein said reinforcement element serves to reinforce said at least one of said rim and said outer flange to resist stress and deflection associated with spoke tensile forces.
134. (New): A wheel according to claim 133, wherein said reinforcement element is connected to said outer flange and is a continuous annular element, including a central opening to surround said axle and wherein said reinforcement element provides at least one of radial and hoop stresses reinforcement to said outer flange.

135. (New): A wheel according to claim 133, wherein said at least one of said spokes is positioned to contact said reinforcement element.

136. (New): A wheel according to claim 132, wherein said interference fit comprises a deformed engagement region between said at least one of said spokes and said cavity and wherein said at least one of said spokes includes a configured surface in said deformed engagement region and wherein said cavity at least partially conforms to said configured surface.

137. (New): A wheel according to claim 136, wherein said configured surface of said at least one of said spokes includes helical threads in said deformed engagement region.

138. (New): A wheel according to claim 136, wherein said configured surface of said at least one of said spokes includes annular ribs in said deformed engagement region.

AM 139. (New): A wheel according to claim 136, wherein said configured surface of said at least one of said spokes includes at least one raked edge in said deformed engagement region, wherein said raked edge is raked in a direction to provide a ramped surface for reduced spoke insertion force into said cavity and a sharp edge for increased spoke pull-out force from said cavity.

140. (New): The wheel of claim 132 wherein said interference fit is between an intermediate connecting member and said at least one of said outer flange and said rim.

141. (New): A wheel according to claim 140, wherein at least two of said spokes are connected to said intermediate connecting member.

142. (New): A wheel according to claim 140, wherein said intermediate connecting member is a collar that surrounds the cross section of said at least one of said spokes.

143. (New): A wheel according to claim 132, wherein said at least one of said spokes has a spoke span portion extending between said outer flange and said rim and wherein said spoke span portion

has a generally flat cross-section with a cross-sectional width greater than its thickness and wherein said cross-sectional width is oriented in a generally tangential direction for reduced aerodynamic resistance in the direction of wheel rotation.

144. (New): A wheel according to claim 132, wherein at least one of said cavity and said at least one of said spokes includes an extendable engagement surface in said deformed engagement region, wherein said extendable engagement surface may be extended to create an overlaid engagement between said extendable engagement surface and the other of said spoke and said cavity.

145. (New): A wheel according to claim 144, wherein said extendable engagement surface may be passively retracted.

AM 146. (New): A wheel, comprising:
a peripheral wheel rim;
a central hub with a central axle and an outer flange;
a plurality of spokes extending between the rim and the hub, wherein each of said spokes have a first portion connected to said rim and a second portion opposed to said first portion and connected to said hub; and
a cavity formed within at least one of said outer flange and said rim for connection with at least one of said spokes;
wherein at least one of said first portion and said second portion of said at least one of said spokes is joined to said cavity by a gripping and locating engagement in a region of overlap between said at least one of said spokes and said cavity in a deformed engagement region.

147. (New): A wheel according to claim 146, wherein said cavity has an open end and a second end opposed to said open end, wherein said second end is at least partially closed and wherein said spoke contacts said second end to provide a longitudinal depth stop for said spoke.

148. (New): A wheel according to claim 146, wherein said at least one of said spokes includes a first spoke and a second spoke engaged within a common one of said cavity in said deformed engagement region.

149. (New): A wheel according to claim 148, wherein said first spoke is engaged with said second spoke.

150. (New): A wheel according to claim 146, wherein said cavity includes two ends with sidewalls extending between said two ends, and wherein said deformed engagement region comprises a deformed engagement between said at least one of said spokes and at least a portion of said sidewalls of said cavity.

am 151. (New): A wheel according to claim 146, wherein said cavity is a through cavity, including two open ends.

152. (New): A wheel according to claim 146, wherein said cavity is located in said rim, and wherein said gripping and locating engagement provides a firm connection between said at least one of said spokes and said rim.

153. (New): A wheel according to claim 152, wherein said cavity only partially surrounds the cross section of said at least one of said spokes in at least a portion of said deformed engagement region.

154. (New): A wheel according to claim 146, wherein said cavity is a through cavity with a first open end and a second open end, with a first of said at least one of said spokes extending from said first open end and a second of said at least one of said spokes extending from said second open end.

155. (New): A wheel according to claim 146, wherein said cavity includes a configured surface in said deformed engagement region and said at least one of said spokes at least partially conforms to said configured surface of said cavity.

156. (New): The wheel of claim 146 wherein said at least one of said spokes has a cross-sectional thickness in said engagement region and wherein said engagement region is a longitudinal engagement region including a longitudinal depth of engagement that is greater than said cross-sectional thickness.

157. (New): The wheel of claim 156 wherein said depth of engagement is at least 2 times the cross-sectional thickness.

158. (New): A wheel according to claim 146, including a clamping member, wherein said at least one of said spokes is sandwiched in said deformed engagement region by said clamping member.

AM 159. (New): A wheel according to claim 146, including a spoke joining member connected to said at least one of said rim and said outer flange, wherein said spoke joining member includes said cavity, and wherein said at least one of said spokes is engaged to said cavity at said deformed engagement region.

160. (New): A wheel according to claim 159, wherein said spoke joining member is an annular element, including a central opening to surround said central axle.

161. (New): A wheel according to claim 146, including a secondary mechanical engagement element to simultaneously engage said at least one of said spokes and said at least one of said outer flange and said rim.

162. (New): A wheel according to claim 146, including a generally straight spoke span portion extending between said outer flange and said rim and wherein said spoke span portion has a longitudinal axis and wherein said deformed engagement region has a longitudinal axis and wherein said longitudinal axis of said spoke span portion is aligned to be generally collinear with said longitudinal axis of said deformed engagement region.

163. (New): A wheel according to claim 146, wherein said at least one of said spokes is bent in a region external to said deformed engagement region.

164. (New): A wheel according to claim 163, wherein said cavity is aligned in a generally axial orientation.

165. (New): A wheel according to claim 163, wherein at least one of said rim and said outer flange includes a spoke guiding portion that is located external to said deformed engagement region, wherein said spoke guiding portion serves to support said spoke in said bent region.

166. (New): A wheel according to claim 165, including an annular supporting element that surrounds said axle, wherein said annular supporting element includes said spoke guiding portion.

167. (New): A wheel according to claim 146, wherein said at least one of said spokes is a duplicate spoke constituting a continuous element with two structural spans between said rim and said central hub, including a common portion joined to said cavity in said deformed engagement region.

168. (New): A wheel according to claim 146, wherein said at least one of said spokes includes a generally circular cross-section portion located within said deformed engagement region.

169. (New): A wheel, comprising:

a peripheral wheel rim;

a central hub with a central axle and an outer flange;

a plurality of spokes extending between the rim and hub, wherein each of said spokes have a first portion connected to said rim and a second portion opposed to said first portion and connected to said hub; and

a cavity formed within at least one of said outer flange and said rim for connection with at least one of said spokes;

wherein a joined one of said first portion and said second portion of at least one of said spokes is joined to said cavity with said cavity engaging said joined one to maintain at least one of

said cavity and said joined one in a deformed condition.

170. (New): A wheel according to claim 169, wherein said joined one may be disassembled from said cavity without damaging said cavity and wherein said joined one may be reassembled to said cavity after said disassembly to reestablish a firm connection between said spoke and said cavity.

171. (New): A wheel according to claim 169, wherein:

said outer flange is a first outer flange for said connection with said second portion of a first of said spokes;

said central hub comprises a second outer flange joined to said second portion of a second of said spokes; and

said first outer flange is axially separated from said second outer flange by a spacer portion.

172. (New): A wheel according to claim 171, wherein said first outer flange and said second outer flange are separate pieces.

173. (New): A wheel according to claim 172, wherein said first outer flange and said second outer flange are rotatably keyed to maintain a fixed angular orientation between said first outer flange and said second outer flange.

174. (New): A wheel according to claim 172, further comprising means for fastening said first outer flange to said second outer flange so that said first outer flange and said second outer flange may be detached and reattached.

175. (New): A wheel according to claim 171, wherein said first outer flange, said second outer flange and said spacer portion are formed as a single contiguous unit.

176. (New): A wheel, comprising:
a peripheral wheel rim;

a central hub having an axle and an outer flange;
a plurality of spokes extending between the rim and hub, wherein each of said spokes have a first portion connected to said rim and a second portion opposed to said first portion and connected to said hub; and

a cavity formed within said outer flange for engagement with said second portion of at least one of said spokes;

wherein:

said second portion of at least one of said spokes is joined to said cavity in a longitudinal engagement region by a longitudinal engagement comprising at least one of a continuous longitudinal engagement and a multiplicity of longitudinally spaced discontinuous engagement locations over a longitudinal distance;

said at least one spoke has a cross-sectional thickness in said engagement region and said longitudinal distance is greater than said cross-sectional thickness;

said longitudinal engagement provides a firm connection between said outer flange and said second portion of said spoke at said engagement region; and

wherein at least a portion of said outer flange in said engagement region comprises polymeric material.

177. (New): A wheel according to claim 176, wherein said at least one of said spokes includes configured geometry to engage said cavity and said cavity includes configured geometry to engage said at least one of said spokes and wherein said configured geometry of said at least one of said spokes is interlocked with said configured geometry of said cavity in said engagement region.

178. (New): A wheel according to claim 176, wherein said configured geometry of said at least one of said spokes is a helical male thread, and wherein said configured geometry of said cavity is a helical female thread to mate with said male thread in a threaded engagement in said engagement region.

179. (New): A wheel according to claim 176, wherein said cavity is an open cavity with an open portion of at least one sidewall of said cavity.

180. (New): A wheel, comprising:

a peripheral wheel rim;

a central hub with an axle and an outer flange;

a plurality of spokes extending between the rim and hub, wherein said spokes have a first portion connected to said rim and a second portion opposed to said first portion and connected to said hub; and

a cavity formed within at least one of said rim and said outer flange for connection with at least one of said spokes;

wherein:

said cavity includes at least one open end and at least one longitudinal sidewall surface;

said at least one spoke is joined to said cavity by a deformed engagement in a longitudinal deformed engagement region;

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said deformed engagement is a longitudinal deformed engagement comprising at least one of a continuous longitudinal deformed engagement and a multiplicity of longitudinally spaced discontinuous deformed engagement locations over a longitudinal distance;

said spoke has a cross-sectional thickness in said longitudinal deformed engagement region;

wherein said longitudinal distance is greater than said cross-sectional thickness; and

said deformed engagement provides a firm connection between said spoke and said at least one of said rim and said outer flange.

181. (New): The wheel of claim 180 wherein said longitudinal distance is at least 2 times said cross-sectional thickness.

182. (New): A wheel according to claim 180, wherein said longitudinal deformed engagement region is an obliquely extending engagement region that is radially offset from the central axial axis of said axle.

183. (New): A wheel according to claim 182, wherein said longitudinal deformed engagement region extends though an imaginary radial line perpendicular to a central axial axis of said central hub and perpendicular to a longitudinal axis of said cavity.

184. (New): A wheel according to claim 182, wherein said at least one of said rim and said outer flange includes a multiplicity of clockwise-radiating oblique spokes and a multiplicity of counterclockwise-radiating oblique spokes joined thereto, wherein at least one of said clockwise-radiating oblique spokes is axially offset from at least one of said counterclockwise-radiating oblique spokes.

185. (New): A wheel according to claim 180, wherein said at least one of said rim and said outer flange includes a first such cavity associated with a first longitudinal deformed engagement region and a second such cavity associated with a second longitudinal deformed engagement region, wherein said first cavity is at least one of radially and axially offset from said second cavity.

186. (New): A wheel according to claim 180, wherein said at least one of said rim and said outer flange includes a first such cavity associated with a first longitudinal deformed engagement region and a second such cavity associated with a second longitudinal deformed engagement region, wherein said first longitudinal deformed engagement region is crossed over said second longitudinal deformed engagement region, resulting in a crossover region of close proximity between said first longitudinal deformed engagement region and said second longitudinal deformed engagement region.

187. (New): A wheel according to claim 186, including a first of said spokes connected to said first cavity and a second of said spokes connected to said second cavity, wherein said first of said spokes contacts said second of said spokes in said region of close proximity.

188. (New): A wheel according to claim 186, wherein said first longitudinal deformed engagement region is crossed over said second longitudinal deformed engagement region as viewed in the axial plan view, resulting in said crossover region of close proximity between said first

longitudinal deformed engagement region and said second longitudinal deformed engagement region.

189. (New): A wheel according to claim 188, including an angle of crossover between said first longitudinal deformed engagement region and said second longitudinal deformed engagement region, wherein said angle of crossover, as measured radially outwardly from said crossover region in the axial plan view, is less than 180 degrees.

190. (New): A wheel according to claim 188, including an angle of crossover between said first longitudinal deformed engagement region and said second longitudinal deformed engagement region, wherein said angle of crossover, as measured radially outwardly from said crossover region in the plan view, is greater than or equal to 180 degrees.

191. (New): A wheel according to claim 186, wherein said at least one of said rim and said outer flange includes a third such cavity associated with a third longitudinal deformed engagement region, wherein said first longitudinal deformed engagement region extends to crossed over said third longitudinal deformed engagement region, resulting in a second of such crossover region of close proximity between said first longitudinal deformed engagement region and said third longitudinal deformed engagement region, wherein said first longitudinal deformed engagement region serves as a reinforcing span between said crossover region and said second crossover region.

192. (New): A wheel according to claim 191, including at least two of said reinforcing spans, wherein said reinforcing spans are interconnected by means of at least two of said crossover region to provide a full circumference of said reinforcing spans to provide hoop strength reinforcement of said outer flange about its axial axis.